FOREST INSECT CONDITIONS
IN THE
NORTHERN ROCKY MOUNTAINS
1951

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL RESEARCH ADMINISTRATION
BUREAU OF ENTOMOLOGY AND PLANT
QUARANTINE

FOREST INSECT LABORATORY
COEUR D'ALENE, IDAHO
JANUARY 1952

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Division of Forest Insect Investigations

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Forest Insect Laboratory
Coeur d'Alene, Idaho
February 1, 1952

ACKNOWLEDGMENTS

This report has been made possible only by the cooperation of many individuals who detected and reported insect outbreaks in various parts of the region, or who assisted the laboratory in other phases of its forest insect survey program during the year. Representing individual land owners, timber-owning companies, lumber companies, timber protective associations, lumber associations, or other State or Federal forestry and park agencies, these persons materially assisted the laboratory in ferreting out new insect outbreaks or in gaging the trend of existing ones. Their help is gratefully acknowledged, together with that of many others who were equally alert, but who, fortunately, found no outbreaks to report.

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ABSTRACT

A function of the Coeur d'Alene Forest Insect Laboratory under the Forest Pest Control Act passed by Congress in 1947 is the conducting of forest insect surveys in the forests of the northern Rocky Mountains. To undertake these annually over 39.5 million acres of forest land in northeastern Washington, northern Idaho, Montana, and the northwestern parts of Wyoming and South Dakota requires the help of many cooperators. In carrying out the 1951 survey program the laboratory received the cooperative assistance of 100 individuals representing 11 private, state, and federal forest owner or managing agencies.

Three kinds of forest insect surveys were used: (a) detection surveys constituting the initial report of insect infestations, 131 in number; (b) reconnaissance surveys, a following examination of the more potentially serious infestations reported by the detection surveys, 15 in number; and (c) appraisal surveys, an intensive examination of infestations recommended and approved for control, 10 in number. Most of the detection surveys were made by the cooperators while the laboratory completed the more intensive reconnaissance and appraisal surveys, some with the assistance of cooperator personnel. Forested area covered by the 1951 insect surveys included 20,000,000 acres by detection surveys, 1,989,000 acres by ground and aerial reconnaissance surveys, and 118,000 acres by appraisal surveys. In examinations of bark beetle infestations, currently infested trees were located on 39 miles of chain-wide compass-controlled strips on reconnaissance type surveys and on 494 miles of strips on appraisal surveys. In addition, a total of 53,588 trees were individually examined for signs of bark beetle attacks on unplotted traverses in connection with reconnaissance surveys. The laboratory also employed 11½ hours of flying time by fixed-wing aircraft to cover 1,280,000 acres of forest lands in northern Idaho and western Montana. The U. S. Forest Service provided additional aerial reconnaissance for 384,000 acres.

Epidemic infestations of bark beetles were localized throughout the region. Four outbreaks of the mountain pine beetle (Dendroctonus monticolae) varying in size from 36,000 to 100,000 acres each flourished in valuable old-growth western white pine stands on private, state, and federal lands in parts of the Clearwater, St. Joe, and Coeur d'Alene river basins in northern Idaho during the year. Timber killed by the beetle in these areas in 1950 and 1951 averaged from 1.7 to 7.3 per cent of the pine stands. The volume of white pine killed on the four areas in 1951 is estimated at 73,033,000 board feet. Throughout the remainder of the white pine type 1951 beetle-caused tree mortality averaged 0.1 trees, or 50 board feet, per acre in the old-growth stands.

Mountain pine beetle epidemics in lodgepole pine were limited in 1951 to 13,120 acres on the Kootenai National Forest, Montana (1,880 trees killed); 51,390 acres on the Cabinet National Forest, Montana and adjacent private areas (7,980 trees killed); and 10,900 acres on the St. Joe National Forest, Idaho (1,570 trees killed).

Killing of Douglas-fir by the Douglas-fir beetle (Dendroctonus pseudotsugae) was widespread in the region in 1951. Abnormal activity of this beetle was mentioned in 45 of the 161 detection survey reports received by the laboratory. Light epidemic fir beetle infestations were reported from 55,900 acres in the Kaniksu National Forest in northeastern Washington and northern Idaho, 52,000 acres in the Coeur d'Alene National Forest, and 25,000 acres in the Clearwater National Forest, the latter two areas both in northern Idaho.

The most damaging Douglas-fir beetle infestation in recent years spread over 72,900 acres in the North Fork and the Little North Fork of the Clearwater River in Idaho. In 1950 and 1951 the beetle killed an average of 20 percent of the timber in old-growth stands averaging 8,000 board feet of fir per acre. Part of the fir beetle infestation overlapped the heaviest of the mountain pine beetle epidemics in white pine mentioned above.

Infestations of the mountain pine and western pine beetles (Dendroctonus brevicomis) in ponderosa pine, the Engelmann spruce beetle (Dendroctonus engelmanni) in spruce, and of the Oregon pine engraver beetle (Ips oregoni) caused insignificant forest damage throughout the region in 1951.

Of the defoliator insects native to the region only the spruce budworm (Choristoneura fumiferana) caused appreciable damage to the region's forests in 1951. Budworm infestations were very widespread, however, and covered 1.8 million acres. Approximately 1.1 million acres of this total involved Douglas-fir forests in Montana; principally in the Helena, Flathead, Lolo, Lewis and Clark, and Deerlodge national forests. In the Nezperce National Forest, Idaho, the budworm attacked grand and alpine firs in addition to Douglas-fir. Tree defoliation recorded in the region in 1951 was light on 697,100 acres, moderate on 312,900 acres, and heavy on 171,200 acres.

Miscellaneous forest insects reportedly causing little damage included the sequoia pitch moth (Vespamina sequoiae) in lodgepole pine, buprestid and cerambycid wood borers in windfelled coniferous forests, the black pine leaf scale, Nuculaspis californica (Aspidiotus californicus) on ponderosa pine, a Matsucoccus scale on ponderosa pine, and the forest tent caterpillar (Malacosoma disstria) on alder and willow.

Four direct, or applied, laboratory-recommended control programs were undertaken by land owners in 1951 against mountain pine beetle outbreaks involving lodgepole pine stands in western Montana. These varied in size from 565 acres to 7,139 acres in size. The infested trees were treated standing, with one exception, by spraying the infested portion of the boles with orthodichlorobenzene-oil insecticide, a bark penetrating fumigant. On one operation the taller trees were felled, bucked, and sprayed. Cost of the operations varied from $6.14 to $10.34 per tree or from $2.89 to $36.11 per acre. The operations prevented the emergence in 1951 of broods attacking in 1950 and thus contributed to marked reductions in the number of 1951 attacks in the areas treated.

Indirect control of the western pine beetle was provided for in a number of sanitation-salvage logging operations which removed known high insect risk trees from old-growth ponderosa pine stands.

Recommendations have been made by the laboratory for the treatment by aerial spraying of 37,000 acres of spruce budworm-infested Douglas-fir forests in Montana in 1952 and the treatment by bark penetrating insecticides of 6,800 lodgepole pine trees infested by the mountain pine beetle on 10,470 acres in Montana. Land owners are considering the possibilities of combining timber salvage and insect control operations in the extensive Douglas-fir and mountain pine beetle epidemics in northern Idaho.

FOREST INSECT CONDITIONS IN THE NORTHERN ROCKY MOUNTAINS

1951[1/]

INTRODUCTION

Forest insect pests have come to be recognized by many foresters, lumbermen, and administrators of timberlands as a great detriment to the successful growing and complete utilization of forests in the northern Rocky Mountain region. The great amount of insect-caused tree injury or killing that occurs annually in these forests has become more fully appreciated in recent years because of (1) the generally increasing value of forest stumpage, (2) the increased number of forest properties being operated on a sustained yield basis, and (3) the disconcerting revelation of insect-caused timber depletion in old-growth stands being opened to utilization.

Within the past few years there has been more incentive on the part of timberland owners or managers to control epidemic outbreaks of insect pests because of improved insect survey and control techniques. The control of bark beetles, for instance, has been greatly facilitated through the use of new bark-penetrating insecticides. Aerial spraying techniques developed since World War II have also made it economically feasible for the first time to control widespread defoliator insect outbreaks.

Another factor that is making it easier to control outbreaks is the construction of roads into many of the more remote sections of the region. Thus, it is possible now to consider the control of serious bark beetle outbreaks in areas once inaccessible. The intricate logging road systems in the ever-growing number of selectively cut forests, too, have facilitated control by making it possible, in some cases, to bug-proof residual stands through the utilization of high insect risk trees. These roads are frequently available after logging to aid in salvaging any subsequent tree mortality that may arise from wind, fire, disease, or other insects. There are those who believe that the insect problem in the northern Rockies will not be wholly solved until an adequate system of forest roads is available to allow the early detection and prompt control of insect outbreaks in all forested areas of the region.

To those intimately associated with the growing or harvesting of forests, all of these things have shown how necessary it is to learn more about insect pests and the damage they do, the location and seriousness of the current outbreaks, and how they may be controlled. The laboratory has taken advantage of numerous opportunities in 1951 to make available this information.

1/ Compiled by Philip C. Johnson, Entomologist

The status of current forest insect outbreaks in this region has been the subject of a series of annual "forest insect conditions" reports prepared by this laboratory of which the present one is the latest. It is the purpose of this report to present available information on the presence or absence of heavy endemic or epidemic infestations occurring in the region's forests during 1951. The conditions discussed herein are based upon reports made by the laboratory or those received from the cooperators. These have come from all parts of the area served by the laboratory; an area comprising northeastern Washington, northern Idaho, Montana, northwestern Wyoming, and northwestern South Dakota (see map). This area includes the 17 national forests of the Forest Service, Region One, two national parks, and four Indian reservations, as well as extensive tracts of State- and privately-owned land. A summary of land surface and timbered acreages is given in Table 1.

In addition to the status of current insect infestations the report discusses briefly the insect survey procedures used and the direct or indirect insect control measures instituted in 1951 or recommended for 1952.

Table 1. Land area summary of territory served by the Coeur d'Alene Laboratory[1/].

State	Total Area (M acres)	Forest Land (M acres)	Nonreserved Commercial Forest Land (M acres)
Northeastern Washington	5,001	3,910	3,632
Northern Idaho	12,506	10,318	6,864
Montana	93,489	24,238	14,758
Northwestern Wyoming	1,300	1,000	none
Northwestern South Dakota	2,217	64	64
TOTALS	114,513	39,530	25,318

1/ U. S. Forest Service, Region One, forest survey, 1945 re-appraisal.

THE 1951 FOREST INSECT SURVEYS

Survey Cooperators

A responsibility of the laboratory delegated to it under authority of Public Law 110, 80th Congress, 1947, is the conducting of insect surveys in the forests of the northern Rocky Mountains to detect new insect outbreaks, or to observe existing outbreaks and appraise their magnitude. To do this each year over the nearly 38 million acres of forested land in this region obviously is a task far beyond the capabilities of the laboratory's limited

insect survey staff. To assist it in determining the status of forest insect outbreaks in all parts of the region, the laboratory must necessarily depend upon the help of cooperators. The laboratory always has had the assistance of cooperators, but in 1951 an effort was made to secure even more forest insect information from this source. The number of cooperators was increased, more adequate insect detection training was provided, and the technique of reporting outbreaks was simplified.

In 1951 the list of cooperators was augmented by the addition of many employees of private, State, and other Federal timberland owners or managers. Many of these cooperators attended special early summer survey training schools operated by the laboratory. Operation of the schools was greatly facilitated by the assistance received from such private and public agencies as the Western Pine Association, Clearwater Timber Protective Association, Idaho State Department of Forestry, U. S. Forest Service, and the National Park Service. All cooperators were furnished with special forms and urged to watch for and to report to the laboratory any symptoms of insect-caused tree damage evident in forest areas where they were employed.

The laboratory was greatly encouraged by the excellent response received from the cooperators during the year. Many reports were received of new insect outbreaks as well as some for outbreaks whose existence was already known.

Types of Surveys Used

The forest insect surveys employed by the laboratory in the northern Rockies this past year comprised three types which recently have been standardized by the Bureau for use in all forested sections of the United States. These were: (1) detection, (2) reconnaissance, and (3) appraisal surveys. Their definition and use are described in the following paragraphs.

Detection survey. Defined as "an examination or observation of a forested area that results in initial information as to the presence or absence of an insect infestation". Its purpose is to detect outbreaks of injurious insects in forested areas where current knowledge of insect activity is lacking. It is made largely by general observations from the ground or air, either planned or incidental to other woods work. Detection surveys are made most frequently now by representatives of cooperating land managing or owning agencies but sometimes by the personnel of the laboratory. Usually they constitute the initial report of the presence and general location of a forest insect outbreak.

Reconnaissance survey. "An examination of a known infestation to determine its more specific location, the insect responsible, the host, the type and amount of damage, and the need for control." Its purpose is to obtain basic information about an infestation initially reported by a detection survey, from which the possible need for control can be determined. It is used where infestations threaten to damage, or already are damaging, forest resources. It is made by the survey personnel of the laboratory, sometimes with the help of cooperator personnel. It employs ground or aerial methods of sufficient intensity to determine the desirability of control.

Appraisal Survey. A "systematic sampling of an infestation to serve as the basis for detailed planning of a control program, or the determination of the effectiveness of completed control measures". It is employed subsequent to a detection or reconnaissance survey to obtain the quantitative information needed, as stated above, for the planning of a specific control program or the checking of a completed one. It is made by intensively sampling the infestation to get the number, and sometimes the size, of trees to be treated. The detailed location, size, and ownership of at least the portion of the infested area to be treated is also obtained. It is essentially the same as a reconnaissance survey except for its greater intensity of sampling or examination. The appraisal survey is almost always made by, or under the direction of, the survey personnel of the laboratory. This is desirable because the expenditure of large sums of control monies depends, among other things, upon a sound appraisal of the entomological considerations involved in the control planning.

All three types of forest insect surveys were employed in the northern Rockies in 1951. The 156 surveys made during the year were divided into detection surveys, 131; reconnaissance surveys, 15; and appraisal surveys, 10 (Table 2).

Table 2. Types of forest insect surveys conducted in the northern Rocky Mountains in 1951.

Type of Survey[1]	Number Made	Acreage Covered	Man days Expended	Made By
Detection	111		85	Cooperators
	20		15	Laboratory
Sub-totals (estimated)	131	20,000,000[2]	100	
Reconnaissance				
Ground methods	7	305,380	187	Laboratory
	2	19,800	28	Cooperators
Aerial methods	5	1,280,000	2	Laboratory
	1	384,000	1	Cooperators
Sub-totals	15	1,989,180	218	
Appraisal	7	111,560	283	Laboratory
	3	6,830	44	Cooperators
Sub-totals	10	118,390	327	
TOTALS	39	1,696,940	487	Laboratory
	71	410,630	158	Cooperators
	156	22,107,570	645	All agencies

1/ See text for definitions and uses.
2/ Includes area covered by cooperators not reporting active infestations.

The detection surveys obviously were the most numerous. In addition to the 20 surveys made by laboratory personnel, Appendix Tables 1 and 2 show that 89 individuals, most of them representing 11 private, State, and Federal forest management or utilization agencies, submitted a total of 111 detection survey reports during the year. Undoubtedly, these cooperators and others not named made additional detection surveys that did not uncover any abnormal insect activities. There is no way of knowing how many of these were made, however, since no reports are asked for at present where no outbreaks are found.

The reconnaissance surveys were less numerous since they were employed only where the detection surveys indicated potentially serious infestations. Normally, only a relatively small number of infestations reported by the detection surveys require follow-up reconnaissance surveys. Similarly, only a portion of the reconnaissance surveys, those recommending control measures, justify follow-up appraisal surveys. Ordinarily, the latter surveys are the least numerous, just as they were in 1951.

As the abundance of each of the three types of surveys decreased, however, the man-days required to make them increased. In 1951, the more numerous detection surveys required an average of 0.8 man-days to complete, the reconnaissance surveys required 14.5 man-days, and the least numerous appraisal surveys took 32.7 man-days to complete.

The reconnaissance and appraisal surveys are summarized in Appendix Tables 4 and 5.

As in past years, aircraft were used in 1951 to complete part of the insect survey program. The laboratory utilized 11.5 hours of flying time for spruce budworm and bark beetle reconnaissance surveys in Montana and Idaho respectively (Table 3). This time was divided into 5 surveys which together covered an estimated 1,280,000 acres. In addition, the Forest Service conducted one aerial survey which covered an estimated 384,000 acres in northern Idaho (Table 2).

Table 3. Summary of fixed-wing aircraft flights made by the laboratory in the aerial phase of the 1951 forest insect survey program of the northern Rocky Mountains.

Flight No.	Flying Time (hrs.)	Date	Type of Aircraft and Contractor	Area Examined	Infestation Examined
1	½	8/9	STINSON VOYAGEUR Forest Service Kalispell, Mont.	S. Fk. Flathead River, Flathead Nat. For., Montana	Spruce budworm in Douglas-fir
2	2½	8/10	Same	Same	Same
3	2½	8/16	STINSON VOYAGEUR Forest Service Helena, Mont.	Continental Divide Helena N.F., Mont.	Same
4	3	10/8	CURTISS AIR SEDAN Johnson Flying Service, Missoula, Montana	N. Fk. Clearwater River, St. Joe & Clearwater Nat. Forests, Idaho	Douglas-fir beetle in Douglas-fir and Mountain pine beetle in western white pine.
5	3	10/9	Same	Same	Same
5	11½	--------TOTALS			

The laboratory's use of small fixed-wing aircraft for forest insect surveys dates back to July 1930. Their use has increased each year. The advantage of this method of surveying insect outbreaks is in getting entomological observers over newly reported, or as yet un-reported, infestations in the more remote sections of the region. In this way quick estimates can be made of the approximate infested acreage and, in some instances, of the number of infested trees. This information frequently aids in the proper placement of ground crews whose subsequent task is to make more detailed ground examinations of the infestations.

More widespread use of fixed-wing aircraft for forest insect surveys is limited in this region, however, for a number of reasons. Chief among these is the inability to recognize from the air trees in some forest types currently infested with bark beetles or those lightly damaged by defoliating insects. Contributing factors are (1) delay in crown fading of beetle-infested trees for as much as a year or more following attack, (2) the inconspicuousness of individual tree crowns in dense, even-aged stands, notably western white and lodgepole pine stands, and (3) the relatively high air speeds and flying altitudes required of fixed wing aircraft over rough topography. The slower air speed and lower flying altitude of the helicopter promises to overcome these objections, but at present its operation is considered too expensive for general survey use.

CURRENT BARK BEETLE OUTBREAKS

Detection survey reports (Appendix Table 3) seemingly indicate that bark beetles were present over a large part of the northern Rocky Mountain region in 1951. It was subsequently determined, however, that they were not present in sufficient numbers in most areas to cause significant damage to the forests in which they were found. In northwestern South Dakota and in Yellowstone National Park, Wyoming, bark beetle infestations were practically non-existent and the forest damage resulting from the small beetle populations in these areas was almost indistinguishable. This same situation prevailed throughout most of Montana and in the greater portion of Idaho's panhandle.

The major bark beetle outbreaks reported in 1951 were somewhat localized, but where they occurred, the beetle populations were dense and the damage to the forests caused by their attacks was great. In several instances in northern Idaho, the damage was so extensive that considerable concern was exhibited by the timberland owners involved even before the situations had been completely surveyed.

The Mountain Pine Beetle (Dendroctonus monticolae)

In western white pine.

Epidemic outbreaks of the mountain pine beetle flourished in several of the region's valuable western white pine forests during 1951. The outbreaks, four in number covering an estimated 36,000 to 100,000 acres each, were located in several of the main river drainages in northern Idaho: (1) North Fork Clearwater, (2) Little North Fork Clearwater, (3) upper St. Joe, and (4) North Fork Coeur d'Alene. Reconnaissance surveys made in the first three areas yielded information on their location, extent, timber type and general merchantable value, and the percentage of the stands infested in 1950 and 1951. Funds were not available to conduct more detailed appraisal surveys needed to provide unit-by-unit estimates of the number and volume of pine trees killed in these areas in 1951. It was possible, however, to conduct such a survey in the North Fork Coeur d'Alene River area.

Perhaps the most virulent outbreak was that located in the Little North Fork Clearwater River area. Here, in an area of 68,100 acres of State- and privately-owned white pine timberlands, the mountain pine beetle caused pine mortality equal to an average of 7.3 percent of the stand in the last two years (Table 4). This tract covers a large part of the 60,000-acre Floodwood State Forest containing what is perhaps the finest remaining merchantable stand of western white pine. The infestation reached alarming proportions in several parts of the infested tract. The average percentage of stand killed by the beetle in 1951 was 5.4 in the Stocking Meadows Unit (6,000 acres), 3.5 in the Floodwood Creek Unit (15,700 acres), 3.3 in the Lower Isabella Creek Unit (3,200 acres), and 2.6 in the Silver Creek Unit (15,000 acres).

Table 4. Average percentage of stands killed by the mountain pine beetle in old-growth western white pine forests, St. Joe and Clearwater River basins, Idaho, 1950 and 1951.

Area	Principal Timberland Owner	Infested Acreage	Average Percentage of Stand Killed (No. of Trees)[1] 1950	1951	1950-51
N. Fk. Clearwater River	Clearwater Nat'l For.	77,100	0.3	1.4	1.7
	State and private	15,000	0.9	2.6	3.5
Little North Fork Clearwater River	State and private	68,100	3.9	3.4	7.3
	SUB-TOTALS	160,200	1.9	2.4	4.3
St. Joe River	St. Joe Nat'l. For.	100,500	1.0	1.0[2]	2.0
	TOTALS	260,700	1.6	1.9	3.5

1/ Based upon basal examination of 41,916 green and infested pine trees on unplotted traverses in the Clearwater River basin and of 9,763 similar trees in the St. Joe River basin.

2/ Estimated.

The outbreak in the North Fork Clearwater River drainage covering 92,100 acres in the Clearwater National Forest and adjacent private- and state-owned lands was only slightly less spectacular with an average loss of timber in 1950 and 1951 equal to 2 per cent of the pine stand. However, the trend of the infestation appeared to be increasing in contrast to the situation on the aforementioned Little North Fork Clearwater River area which seemed comparatively unchanged between 1950 and 1951. The North Fork Clearwater outbreak, in showing an average increase in the average percentage of stand killed of from 0.4 in 1950 to 1.6 in 1951, definitely changed from endemic to epidemic status.

In this area, too, some individual units showed remarkably heavy stand mortality from the mountain pine beetle in 1951. The percentage of the pine stand killed averaged 4.7 in Isabella Creek (3,800 acres), 10.5 in Sheep Mountain (1,500 acres), and 2.2 in Quartz Creek (11,000 acres).

It is conservatively estimated that western white pine stands will average about 20,000 board feet per acre in pine volume over most of the 160,000-acre infested area in the Clearwater River basin. Assuming a consistent volume per tree throughout the area, the data in Table 4 indicate that 51,200,000 board feet of old-growth white pine was killed by the mountain pine beetle in this area in 1950, 70,400,000 board feet in 1951, or a total of 121,600,000 board feet in the last two years. This was equivalent to a

per acre loss of 320 board feet in 1950, 440 board feet in 1951, or a total of 760 board feet for the two years. The pine timber destroyed by the beetle on this area during the past two years represents a loss in stumpage value alone of between 2⅔ and 3⅓ million dollars.

The St. Joe River outbreak covered an estimated 100,000 acres south and east of Avery, Idaho. It was surveyed in July 1951 before many of the 1951 attacks had appeared, consequently pine mortality estimates for 1950 are all that are available at this time. These indicate that an average of 1 percent of the pine stand had been killed in this year. An infestation responsible for this degree of stand mortality may be regarded as highly endemic and approaching epidemic status.

The fourth and last of the major white pine infestations to be mentioned here occurred in part of the Coeur d'Alene National Forest. It centered in an area of 36,000 acres in the Yellow Dog-Downey Block of the Forest. This block reputedly holds the largest remaining body of federally-owned uncut white pine. It has been the scene of persistent mountain pine beetle epidemics that have resulted in serious depletion of the stands. In one 16,000-acre tract (Sissons, Yellow Dog River, Yellow Dog Creek, Downey, and North Yellow Dog Units), a total of over 134,000 mature white pine trees containing over 67,000,000 board feet have been killed by the beetle between 1929 and 1950. This represents an average annual loss of 0.38 trees, or 190 board feet, per acre; considerably more than the estimated average annual gross increment.

Pine losses from the beetle would have been even greater had not a series of 10 direct control projects been conducted by the Forest Service on the advice of the laboratory. These were undertaken between 1929 and 1948 in various parts of the tract. Lack of funds precluded complete extermination of the infestations, but the treatment of 29,287 trees during the 20-year period did succeed in knocking down "hot spot" epidemics that developed above the general infestation level here and there throughout the tract in some years.

In 1951 an appraisal survey of the Yellow Dog-Downey Block showed that the beetle had killed in this one year 5,246 trees on the 35,000 acres, or an average of 0.15 trees (75 board feet) per acre (Table 5). The fact that this is less than one-half of the average annual beetle-caused tree mortality recorded from this general area during the past 22 years may be due to (1) a decline in the severity of the infestation or (2) the effect of the same severe infestation upon a greatly depleted stand. Notwithstanding the relatively low tree-per-acre loss, the 1951 infestation added another 2⅔ million board feet to the ever-growing volume of beetle-killed timber in this area.

Table 5. Western white pine timber killed by mountain pine beetle infestations in the Yellow Dog-Downey area, Coeur d'Alene National Forest, Idaho, 1951.

Unit	Pine Type Acreage	Number of Trees Killed By The Beetle in 1951 Per Acre	Total
Sissons Creek	4,700	.17 ± .04	799 ± 188
Yellow Dog River	2,140	.09 ± .03	193 ± 64
Yellow Dog Creek	4,120	.22 ± .09	906 ± 371
Downey Creek	4,160	.38 ± .15	1,580 ± 624
North Yellow Dog	840	.33 ± .17	277 ± 143
Bennett Creek	580	.30	174
Brett-Miner	1,550	none	none
Rock City	1,600	.30 ± .21	480 ± 376
Hawkseye	8,780	.03 ± .02	263 ± 175
Upper Flat Creek	3,680	.10 ± .06	368 ± 22
Lower Flat Creek	4,120	.05 ± .03	206 ± 124
	36,270	.15 ± .03	5,246 ± 1,088

The four outbreaks just described represent areas where mountain pine beetle populations were concentrated in 1951. Elsewhere thoroughout the white pine region, especially in the mature stands, a small and almost undetectable beetle-caused tree mortality occurred. In most cases, gross mortality is believed to have averaged about 0.1 trees, or 50 board feet, per acre for the year. While this mortality might be economically insignificant, it indicates the presence of beetle populations which, under certain favorable circumstances, could become the nucleus of damaging outbreaks in the more susceptible stands.

In Lodgepole Pine.

On the basis of reports received most of the region's extensive lodgepole pine stands in western Montana and Yellowstone National Park were notably free of damage from the mountain pine beetle in 1951. In 1949 and 1950 some of the region's most damaging bark beetle infestations were those of the mountain pine beetle in the lodgepole pine stands of the Thompson River and of the Yaak and Kootenai River basins in the Cabinet and Kootenai National Forests, respectively, in northwestern Montana. The trend of these infestations declined in 1951 as a result of the combined effects of abnormally heavy insect brood mortality during the winter of 1949-50 and of direct control operations in 1949 and 1950. Consequently, the tree mortality in 1951 was less than it has been for several years. It still is considerable, however, as may be seen in Table 6. On 13,000 acres in the Kootenai National Forest and on 51,000 acres in the Cabinet National Forest a total of 1,880 and 7,980 trees, respectively, were killed by the beetle.

Table 6. Lodgepole pine timber killed by mountain pine beetle infestations in the northern Rocky Mountains, 1951.

National Forest	Infestation Area	Infested Acreage	No. of 1951-killed Trees Per acre	No. of 1951-killed Trees Total
Kootenai (Montana)	Upper Yaak River	7,810	0.15 ± 0.04	1,180 ± 312
	Boulder Creek	2,500	0.17 ± 0.09	430 ± 225
	Big Creek	2,810	0.10 ± 0.04	280 ± 109
	SUB_TOTALS	13,120	0.14 ± 0.03	1,880 ± 424
Cabinet (Montana)	Lynch Lake	1,160	1.09 ± 0.26	1,260 ± 301
	Lost Prairie	2,800	0.15 ± 0.07	420 ± 196
	Thompson Lakes	15,340	0.31 ± 0.03	4,750 ± 460
	Thompson River	32,090	0.05 ± 0.02	1,550 ± 642
	SUB_TOTALS	51,390	0.16 ± 0.02	7,980 ± 1,028
St. Joe (Idaho)	State Line	10,900	0.14 ± 0.034	1,570 ± 370
	TOTALS	75,410	0.15 ± 0.02	11,430 ± 1,508

Lodgepole pine stands in the State Line Unit of the St. Joe National Forest in northern Idaho contained the only other significant infestation of the mountain pine beetle in 1951. Mildly epidemic in 1950, the infestation declined to endemic status in 1951 (Table 6). An infestation of this beetle in lodgepole pine stands of the Jack Creek basin, Beaverhead National Forest, Montana, also subsided naturally in 1951 after causing considerable tree mortality in 1949 and 1950.

In ponderosa pine.

The mountain pine beetle caused little, if any, significant damage to ponderosa pine stands in the region during 1951. A few groups of pine trees killed by the beetle in 1950 appeared in the Spring Creek drainage of the Musselshell Ranger District, Lewis and Clark National Forest, Montana. This is the remnant of an infestation that peaked in this area in 1949, causing considerable damage to the stands. Light, scattered losses also occurred in pole-sized pine stands between Tensed and Troy, Idaho.

From preliminary results of some research studies conducted this year, the laboratory determined that most of the ponderosa pine loss from bark beetles in 1951 was caused by the mountain pine beetle in Montana east of the Continental Divide and in the Blackfoot River basin west of the Divide. In most of the remaining ponderosa pine forests in western Montana, northern Idaho, and northeastern Washington the western pine beetle (Dendroctonus brevicomis Lec.) was responsible for the small pine mortality that occurred.

The Douglas-Fir Beetle (Dendroctonus pseudotsugae)

The most frequent reports received from cooperating agencies during 1951 were those describing damage to Douglas-fir forests by the Douglas-fir beetle (Appendix Table 3). These reports came from areas well scattered over the extensive range of the tree species in the northern Rockies. The reported damage was relatively small in most instances, but the increasing frequency of the reports, coupled with generally increasing damage and mushrooming fir utilization, substantiates a growing realization that this beetle is becoming one of the major obstacles to the successful management of Douglas-fir forests in this region.

This emphasizes a need for re-assessing the importance of the damage caused by the beetle. Heretofore, the sporadic nature of the outbreaks, their short life, the low value of fir stumpage, and the high cost of adequate control measures forced most land-managing agencies to become resigned to the value of the beetle-caused damage. Douglas-fir, however, occupies a foremost ranking in the northern Rocky Mountain region's forest resource and utilization picture (Table 7). The damage resulting from even the so-called light

Table 7. Volume of softwood sawtimber[1/] in the unreserved commercial forests of the northern Rocky Mountains, by species[2/].

Tree Species	N. E. Washington	Northern Idaho	Montana	N. W. So. Dakota	Regional Totals
		Million board feet			
Western white pine	503	11,523	1,107	-	13,133
Ponderosa pine	4,293	6,493	11,514	12	22,312
Western larch	2,343	5,969	11,807	-	20,119
Douglas-fir	3,412	9,070	12,595	-	25,077
True firs	192	7,598	918	-	8,708
Western redcedar	412	4,070	350	-	4,832
Hemlock	133	1,184	168	-	1,485
Engelmann spruce	148	3,168	6,042	-	9,358
Lodgepole pine	99	1,319	7,453	-	8,871
Others	-	-	158	-	158
State Totals	11,535	50,394	52,112	12	114,053

1/ Cedar and pines larger than 11.0 inches d.b.h.; other species larger than 13.0 inches d.b.h.

2/ From U. S. Forest Service, Region One, forest survey, 1945 reappraisal. Volumes as of January 1, 1945.

infestations is no longer being condoned. Greater concern by timberland owners over Douglas-fir beetle damage is reflected in increased requests to the laboratory for information on the habits of the beetle, causes of the outbreaks and of their natural decline, and methods of applied control. Unfortunately, much of this information is meager or outmoded and more adequate information must await results of research efforts in this direction.

While the 1951 detection survey reports indicated recognizable damage in many Douglas-fir stands, there appeared to be definite concentrations of heavy endemic and of epidemic infestations in some areas. The location of the harder-to-observe endemic and light epidemic infestations was greatly facilitated by a questionnaire sent to all national forest supervisors in the region in October by the regional office of the Forest Service at Missoula, Montana. Returns showed that light epidemic infestations were present in 1951 on 55,900 acres of the Kaniksu National Forest in northeastern Washington and in northern Idaho, on 52,000 acres in the Coeur d'Alene National Forest, and 25,000 acres in the Clearwater National Forest.

An extremely heavy infestation, in fact, the most damaging in the region in recent years, developed to epidemic status in 1950 over a wide area in the North Fork Clearwater River drainage in northern Idaho. Because the crowns of the infested trees did not fade until 1951, the epidemic was not generally observed until then. In this year reports of the infestation came from the Idaho State Forestry Department, U. S. Forest Service, Clearwater Timber Protective Association, and private timberland owners. Beginning at the mouth of the North Fork, the infestation occurred in patchwork fashion a distance of 40 miles upstream in a strip 3 to 6 miles wide along both sides of the river. Most of the infested timber was on State- and privately-owned lands. The infested patches of timber were well scattered, from 20 to 3,500 acres in size, and totalled about 110 in number.

In some drainages the concentration of beetle-infested trees was so great that most of the Douglas-fir timber type appeared brilliantly red from the air and from the fire lookout stations. Solid blocks of red-topped trees covered an estimated 2,400 acres in Bathhouse Creek, 2,760 acres in Silver Creek, 2,080 acres in Little Silver Creek, and 1,600 acres in Elmberry Creek--all in the North Fork Clearwater River basin. Other less solidly blocked concentrations of "red tops" appeared scattered over 40,500 acres in the Floodwood Creek-Stocking Meadows section of the Little North Fork Clearwater River basin.

The extent and severity of the above fir beetle infestations were determined, in part, by limited ground reconnaissance, but mostly by observations made from the air and from all major forest fire lookout stations in the vicinity. The infestations were easily located from these vantage points because of their spectacular appearance. Infested trees attacked in 1950 occurred in large groups with their bright red foliage visible for miles. In some areas whole sections (640 acres) of mountain sides appeared almost solidly red. Once the infestations were located and mapped the survey crews sought many of them out on the ground and made basal examinations of a large number of fir trees to establish the ratio of green to infested trees and, hence, the percentage of the stands killed. Although funds were not available to make an appraisal survey employing systematic sampling of the stands, this method

of reconnaissance surveying revealed completely enough the extremely heavy beetle-caused tree mortality in these excellent quality old-growth fir stands.

The extent of the gross fir stand mortality caused by the Douglas-fir beetle in 1950 and 1951 is shown by infestation areas and units in Table 8. On 48,500 acres (all units except Glover-Stony Creeks) mortality for the two years averaged from 20 to 29 percent of the fir stand, and over the entire 73,000 infested acres it averaged 20 percent.

Table 8. Average percentage of stands killed by the Douglas-fir beetle in old-growth Douglas-fir forests, Clearwater River basin, Idaho, 1950 and 1951.

Unit	Infested Acreage	Average Percentage of Stand Killed (No. of trees) 1/		
		1950	1951	1950-51
NORTH FORK CLEARWATER RIVER				
Benton Creek	8,000	13.8	10.0	23.8
LITTLE NORTH FORK CLEARWATER RIVER				
Stocking Meadows	6,300	13.5	15.0	28.5
Floodwood Creek	15,700	11.1	9.2	20.3
Lower Breakfast Cr.	6,000	10.4	18.1	28.5
Little North Fork River	12,500	12.2	10.1	22.3
Glover-Stony Creeks	24,400	3.1	1.9	5.0
	72,900	10.7	9.3	20.0

1/ Based upon basal examination of 3,289 green and infested fir trees on unplotted traverses. Average per acre volume of Douglas-fir in above areas estimated at 8,000 board feet.

Within the past few years the Douglas-fir beetle has assumed increasing importance in some areas in the region as the cause of the death of many trees damaged by the spruce budworm. Many Douglas-fir trees that otherwise might have survived the budworm defoliation have been attacked and killed by the beetle. Follow-up beetle infestations developed in several budworm-infested areas on the Helena National Forest in 1948 and 1949. In 1951 similar killing by the beetle was recorded from several localities in the South Fork of the Flathead River, Flathead National Forest, Montana. This was especially evident in the vicinity of Helen Creek, Damnation Creek, and Brown Sandstone Mountain. Bole examinations of the infested trees indicated that many beetle attacks had been pitched out (i. e., they were unsuccessful), many did not completely encircle the boles, and that, in general, they lacked the vigor of aggressive primary tree-killing attacks. Even these desultory attacks, however, resulted in the killing of several thousand trees in these limited localities and many more scattered at random throughout the basin.

The Western Pine Beetle (Dendroctonus brevicomis)

No serious outbreaks of the western pine beetle were reported from ponderosa pine forests in the region during 1951. Of the two detection survey reports dealing with this beetle, both cited only minor and very localized damage. In the mature and overmature stands throughout the region, it is estimated that the beetle-caused tree mortality averaged from 5 to 10 board feet per acre for the year.

The Engelmann Spruce Beetle (Dendroctonus engelmanni)

Expected outbreaks of the Engelmann spruce beetle in 1951 in parts of the Flathead and Kootenai National Forests in northwestern Montana did not materialize. It was thought that these might develop from beetle broods which bred in and emerged from large volumes of spruce uprooted in the violent windstorm that traversed the northern part of the region November 27, 1949. While the beetle did attack the windfalls in 1950 and, to some extent, in 1951, broods developed therein were not abundant and their emergence from this material has not resulted to date in any extensive damage to nearby spruce forests.

The Engelmann spruce beetle is a notorious breeder in spruce blowdowns and slash and most of its outbreaks have been associated with these conditions; viz., Colorado, 1939-1951, and recent infestations in central Idaho. Its failure to develop epidemic broods in the millions of board feet of wind-felled spruce in the northern Rockies in 1950 and 1951 possibly may be explained, in part at least, by the super-abundance of host material and the comparative absence of the beetle in these two years. Before beetle populations could build up to epidemic proportions, the cambium of much of the wind-felled material had dried sufficiently enough from all indications to effectively curb successful brood development.

This does not always happen, especially in the case of smaller blowdowns. The 1951 forest insect survey provided the concluding record of a small but violent spruce beetle outbreak that had its origin in the beetle populations bred in a small blowdown in Canyon Creek, Flathead National Forest, Montana. The blowdown occurred prior to 1948. The infestation developed in a nearby stand of high quality Engelmann spruce in 1948, rose to a peak in 1949, and subsided in 1951. The Forest Service records attest to its destructiveness during this period:

Infested acreage	98
Trees killed:	
Total number	1,729
Total volume, b. m.	1,330,000
Number per acre	17.6
Volume per acre, b. m.	13,570
Average volume, b. m.	770

In separate surveys made by the laboratory, cruises of infested trees on a single sample strip through the above infested area showed 18 spruce trees attacked in 1948, 78 trees in 1949, 2 trees in 1950, and 1 tree in 1951. These figures, and those above by the Forest Service, illustrate the danger of beetle infestations emanating from small, isolated blowdowns and, too, the rapidity with which these may develop. Even though they may subside naturally, as this one did, they extract a heavy toll of trees.

The Oregon Engraver Beetle (Ips oregoni)

Damage to commercial pine forests in the region due to outbreaks of the Oregon engraver beetle was almost non-existent in 1951. The beetle continued to be a nuisance to farm woodlot and summerhome owners and to some suburban dwellers because of its damage to ponderosa pine trees valued for cordwood or for aesthetic reasons. In many instances the numerous outbreaks reported during the year caused great concern to a number of people though the trees involved were few in number. Much of the damage or outright death of trees caused by the beetle in 1951 could have been prevented had the farmers or summerhome owners realized that it breeds rapidly during the summer months in freshly cut slash and that the resultant beetle broods emerge from the slash and frequently attack nearby green trees. Many of the small engraver beetle outbreaks scattered throughout the region in 1951 could be attributed directly to attacks from beetles that had emerged from pine slash left lying during the summer months of 1950 from road or pole-line right-of-way clearing operations or from tree thinning operations.

The most prominent engraver beetle outbreak to occur during the year was reported from numerous farm woodlots east of U. S. Highway 2 between Kalispell and Columbia Falls, Montana. Here, hundreds of mature and overmature ponderosa pine trees were top-killed as a result of engraver beetle attacks in the upper tree crowns late in 1950. The pine slash from which the beetles emerged was believed to have been created from power line and road clearing operations conducted in the vicinity early in 1950 or late in 1949.

CURRENT DEFOLIATOR INSECT OUTBREAKS

The Spruce Budworm (Choristoneura funiferana)

A number of forest tree defoliating insects are native to the northern Rocky Mountains and, at times, outbreaks of some of them have caused widespread tree damage or mortality. In 1951 only one of these, the spruce budworm, caused any damage in the region. Probably never have defoliator outbreaks been more widespread in the region, however, than those of the budworm this year.

Smaller budworm outbreaks have come and gone upon numerous occasions, but the present series of large outbreaks is the outgrowth of a few localized infestations that appeared chiefly in Douglas-fir stands on the eastern slopes of the Continental Divide in the Helena, Deerlodge, and Gallatin National Forests, Montana, about 1947. Since then they have spread to other fir stands along these same slopes. In 1949 and 1950, budworm infestations appeared in extensive areas of Douglas-, grand, and alpine firs in Idaho; chiefly on the Powell Ranger District of the Lolo National Forest, on lands of the Potlatch Forests, Inc., south of Lewiston, and on the Salmon River Ranger District of the Nezperce National Forest. In this period infestations also appeared in various places along the western slopes of the Continental Divide.

In 1951 the budworm situation in the region was characterized by (1) a more general appearance of outbreaks in areas west of the Continental Divide, (2) some new but small outbreaks along the eastern slopes of the Divide, principally in the Gallatin National Forest and extending into Yellowstone National Park, (3) a decline in the severity of the infestation in the South Fork Flathead River drainage, (4) an increase in infested acreage and resultant damage and a gradual spread northward toward valuable Christmas tree growing areas of the budworm infestations in the Swan River valley in the Flathead National Forest, and (5) an increase in the severity of tree damage caused by current infestations on the Nezperce National Forest.

Within the region probably 90 percent of the budworm infestations in 1951 were in Douglas-fir forest type. The declining infestation in Glacier National Park was associated with Engelmann spruce, those south of Lewiston, Idaho with Douglas- and grand firs, and the infestation on the Nezperce National Forest with both these tree species and, at higher elevations, with alpine fir.

The budworm is peculiar in that its feeding in any one year is confined largely to the current season's needle growth. Unlike most defoliators whose voracious feeding completely divests trees of their foliage in a single season, budworm feeding must continue heavily for a period of from 3 to 6 or 7 consecutive years before complete defoliation and consequent death of the average coniferous tree occurs. Thus, the severity of the accumulated defoliation often indicates the length of time that any particular infestation has been active.

The occurrence of the budworm throughout the region in 1951 is shown in Table 9 by the variation in the severity of the cumulative defoliation as measured this year. Budworm infestations covering 42,000 acres in northern Idaho were classed as light, 12,000 acres moderate, and only 500 acres as heavy. In Montana budworm infestations were much more prevalent and covered a total of 1,126,000 acres of which 654,000 acres contained light, 301,000 acres moderate, and 171,000 acres heavy cumulative defoliation. No severe defoliation, denoting actual tree mortality, was recorded in 1951 if only the overstory of the infested stands is considered. It is known, however, that appreciable amounts of tree mortality occurred in numerous localities in young trees composing the understory of Douglas-fir or mixed conifer stands. In some instances, this seriously affected the 1951 Douglas-fir Christmas tree harvest.

Table 9. Acreage infested by the spruce budworm, by severity of cumulative damage, northern Rocky Mountains, 1951.

Area	Degree of Defoliation			
	Light	Moderate	Heavy	Total
IDAHO				
Nezperce National Forest	10,000	10,500		20,500
Potlatch Forests, Inc.	7,300	1,400	500	9,200
Lolo National Forest	25,300			25,300
SUB-TOTALS	42,600	11,900	500	55,000
MONTANA				
Bitterroot National Forest	6,000	6,000		12,000
Flathead National Forest	59,500	100,000	90,700	250,200
Helena National Forest	376,000	115,000	69,000	560,000
Deerlodge National Forest	80,000	30,000	10,000	120,000
Gallatin National Forest	79,000		1,000	80,000
Lewis & Clark Nat'l. For.	50,000	50,000		100,000
Yellowstone National Park	3,000			3,000
Glacier National Park	1,000			1,000
SUB-TOTALS	654,500	301,000	170,700	1,126,200
TOTALS	697,100	312,900	171,200	1,181,200

MISCELLANEOUS INSECT OUTBREAKS

The Sequoia Pitch Moth (Vespamina sequoiae)

A small outbreak of the sequoia pitch moth in a young, open-grown lodgepole pine stand near the west entrance of Glacier National Park, Montana, remained unchanged in status in 1951. No evident tree damage or mortality has resulted from the infestation which probably covers 100 acres and has persisted for the past 3 or 4 years at about the same insect population level. In 1951 about 50 percent of the trees in the infestation area contained an average of two caterpillars each in copious pitch masses at the root crowns of the trees. Pitch masses from current and previous years' attacks completely encircle some of the trees at this point. Under forest conditions their presence constitutes a hazard in the event of ground fires and in developed areas of the Park they are unsightly from the standpoint of the tourists.

Woodboring Insects In Windfelled Coniferous Trees

The development of flatheaded (Buprestidae) and roundheaded (Cerambycidae) wood borers reached a probable peak in the many patches of coniferous timber uprooted in the northern part of the region during the violent windstorm of

November 27, 1949. Large-scale efforts to salvage sawlogs and poles from the felled material continued through 1951 in the Coeur d'Alene, Kaniksu, Kootenai, and Flathead National Forests as well as on several large privately-owned timber tracts. By the end of the 1951 logging season one lumber company alone had shipped over 750 railroad freight cars of sawed lumber and peeled poles manufactured from blowdown timber in its plant at Libby, Montana.

Borers were not a serious detriment to the salvage of sawlogs from the blowdowns in 1951. The lumber sawed from these logs suffered some degrade due to "worm" holes, but little of it was culled. On the other hand, pole grading rules do not tolerate any worm holes on the peeled surface above the ground line. For this reason salvage of poles was speeded as much as possible to keep ahead of the borer development. By July 1951 the further salvage of western larch poles became questionable because of the prevalence of borer holes. The salvage of lodgepole pine poles was not so affected.

The Black Pine Leaf Scale (Nuculaspis (Aspidiotus) californica)

There was no re-infestation of ponderosa pine by the black pine leaf scale in and around the city of Spokane, Washington, during 1951. An infestation that had been in progress in this vicinity since about 1946 was suddenly ended in March 1950 by subzero air temperatures. Except in one small area immediately northeast of the city, the freeze completely killed all scale populations in the 50-square mile infestation zone. Where the scale insects survived, the populations in 1951 appeared to continue at a heavy level. In this area some additional tree mortality occurred, but it was difficult to ascribe it solely to the effect of the scale infestation despite the external evidence of severe damage which the insects inflicted upon the trees. The continued death of pine trees in this area in 1951 was attributed, in part at least, to other non-insect factors.

Matsucoccus Scale

Damage to ponderosa pine trees believed due to a scale insect species of the genus Matsucoccus occurred in the South Fork Judith River basin of the Lewis and Clark National Forest, Montana, in 1951. The damage was similar to that caused by the Prescott scale, Matsucoccus vexillorum, in the southwestern part of the United States in recent years. It is characterized by the killing of numerous twigs of young or immature trees. The foliage of the infested twigs fades to a light green, thence to a straw yellow, and finally to a bright red. Trees so affected are quite conspicuous in the stand. If the "flagging" damage persists long enough the infested trees are likely to succumb. In the Judith River infestation, however, no tree mortality was apparent from this cause.

The Forest Tent Caterpillar (Malacosoma disstria)

Damage to alder and willow by the forest tent caterpillar was reported from the Colville National Forest, Washington, and from the Lake Coeur d'Alene, Idaho, region during the year. In both instances, the defoliation was not widespread. The Colville outbreak caused some concern to forest rangers because of the abundant "tents", or massed cocoons, in the tops of coniferous trees, notably

alpine fir and western larch. However, the insect merely chose these trees for pupation purposes and did not feed upon them.

INSECT CONTROL PROGRAMS

Direct Control Programs Completed In 1951

Bark beetle control operations employing direct methods were conducted in six localities in northwestern Montana during the year upon the recommendation of the laboratory. All were aimed at controlling mountain pine beetle outbreaks in lodgepole pine forests. They involved the over-all treatment of 6,809 trees on 9,750 acres at a total cost of approximately $57,844, or an average per tree cost of $8.50.

The work was done by the Forest Service. On two projects involving mixed private and government land ownership, the Forest Service was delegated by the private owners and the State of Montana to carry on the control work on their lands within the project area. In both instances, these non-federal owners contributed considerable financial assistance to cover the cost of control work on their lands. On the remaining four projects, only national forest lands were involved and the Forest Service did all the work with pest act funds.

In its role as technical advisor, the laboratory conducted the pre-control appraisal surveys of the areas to be treated, assisted in formulating the technical aspects of the projects, trained spotting and treating crews, checked the application of treating techniques, determined the effectiveness of treatment, and provided other technical services as required.

On 5 of the 6 projects the infested trees were treated standing by spraying an insecticide on the infested part of the boles. The insecticide was made by combining 1 part of orthodichlorobenzene, a liquid fumigant known to entomologists as "ortho" or "ODB", with 5 parts of Diesel oil. The oil alone is partially toxic to the beetle, but its role here was that of a carrier for the ortho. The mixture effectively killed mountain pine beetle broods after it had penetrated through the bark of the trees. It was pumped from 5-gallon "Jeep" cans by stirrup pumps. By using a No. 6 solid-stream spray nozzle and a 12-foot telescopic spray tube, the mixture can be sprayed to a height of 35 feet on standing infested trees.

On one project where some of the infested pines were exceptionally tall, the above treatment was combined with one in which the taller infested trees were first felled and bucked into log lengths so that they could be rolled for spraying. The boles were then sprayed with the ortho mixture by means of modified garden sprinkling cans.

A summary of direct control work done in the region during 1951 is given in Table 10. Because of their small size and close proximity, three projects in the upper Yaak River basin, Kootenai National Forest, Montana, were combined in the tabulation under the name "Upper Yaak River".

Table 10. Summary of direct bark beetle control operations conducted in the northern Rocky Mountains in 1951. (From U.S. Forest Service control reports).

1.	National forest	Cabinet	Cabinet	Kootenai	Kootenai
2.	Project name	Thompson R.	Lynch L.	Boulder Cr.	Upper Yaak River 1/
3.	Land-timber ownership	ACM, NP, S, SP, NF 2/	ACM, NP	NF	NF
4.	Control work done by	Cabinet Nat'l. For.	Kootenai Nat'l. For.	Kootenai Nat'l. For.	Kootenai Nat'l. For.
5.	Duration of work	5/7 - 7/2	5/7 - 5/18	6/6 - 7/5	5/23 - 6/26
6.	Host tree species treated	Lodgepole pine	Lodgepole pine	Lodgepole pine	Lodgepole pine
7.	Insect species treated	Mtn. pine beetle	Mtn. pine beetle	Mtn. pine beetle	Mtn. pine beetle
8.	Acreage treated	7,139	718	565	1,328
9.	Number of infested trees treated:				
	a. Total for project	2,676	1,254	1,973	906
	b. Per acre	0.37	1.74	3.49	0.68
10.	Methods used to treat trees	Spray standing	Spray standing	Fell, buck, & spray	Fell, buck, & spray; spray standing
11.	Number of man-days used	1,359	247	977	570
12.	Cost of control work (approx):				
	a. Total for project	$20,630 3/	$7,704 3/	$20,401	$9,109
	b. Per tree	$ 7.71	$ 6.14	$ 10.34	$10.06
	c. Per acre	$ 2.89	$10.73	$ 36.11	$ 6.86

1/ Combines the Windy Creek, Solo Joe Creek, and Porcupine Creek Insect Control Projects.

2/ SYMBOLS: ACM, Anaconda Copper Mining Co.; NP, Northern Pacific Ry.; S, State of Montana; SP, small private; and NF, national forest.

3/ Financed from a single fund of $28,333.67 made up of Forest Pest Control Act funds ($19,674.36) and funds provided by private timberland owners and the State of Montana ($8,659.31).

The projects showed some variation in the per-tree costs; more in per acre costs. It is difficult, however, to make a direct comparison of these items between different projects because they depend upon such things as (1) accessibility of the treated area, (2) topography and ground conditions (snow, mud, brush, windfalls), (3) the number of trees to be treated per acre, (4) pre-control development needs (road construction or improvement, bridge repairs, camp construction), (5) weather conditions during the period of treatment, and (6) availability of experienced personnel.

An example of this was the Boulder Creek Insect Control Project on the Kootenai National Forest, one of the most difficult small control operations undertaken in recent years. The treating area was in the center of some of the roughest sections of the Purcell Mountains. The extremely steep slopes, the abundance of underbrush, and an almost continuous jackstrawed layer of old lodgepole pine windfalls made tree-to-tree travel everywhere in the area exceptionally difficult. It was necessary to equip treating crews with a gasoline-powered saw to enable them to cut trails through the windfalls so that the insecticide-laden pack trains could keep up with the treating work. The 30-man control camp also had to be located several miles from the nearest road and serviced entirely by pack trains. These conditions, along with nearly 3.5 inches of rain that fell during the 30-day life of the project, made treating both expensive and difficult.

Despite these extremes, it is believed that comparable cost and achievement records shown in Table 10 for the different projects fairly well indicate what it costs at present to subdue mountain pine beetle outbreaks in the lodgepole pine forests of the region.

It is gratifying to note a continuation in 1951 of the cooperation exhibited since 1949 by private land owners and the State and Federal governments in controlling the mountain pine beetle outbreak in theThompson River basin of Montana.

A measure of bark beetle control was obtained on the Coeur d'Alene National Forest in 1951 by the use of small timber sales. Two of these were made along existing roads primarily to remove and utilize trees recently killed by beetles. One sale in the headwaters of Laverne Creek included approximately 100,000 board feet of Douglas-fir one-third of which was contained in trees in which there were active broods of the Douglas-fir beetle. On Beetle Creek, aptly named because of its long history of bark beetle infestations, another sale removed 50 western white pine trees felled by wind during the 1950-51 winter and 250 pine trees in a dead or dying state. Many of the windfalls and most of the dying trees contained active broods of the mountain pine beetle. The dead trees, many of which had been killed recently by the pine beetle, were removed from the stand as a salvage measure. These sales are an excellent example of the manner in which a good road system can contribute to the early control of bark beetle outbreaks or the salvage of beetle-killed and other dead timber.

Indirect Control Programs Completed In 1951

Prevention of western pine beetle outbreaks in ponderosa pine and of mountain pine beetle outbreaks in western white pine forests was extended further in the region in 1951 by a number of sanitation-salvage logging operations. These accomplished the removal, along with other trees, of high insect risk

pine trees which entomologists have shown are normal breeding places for these two beetles and the nucleus of epidemic infestations. Additional cuttings of this kind were made by several lumber companies in their ponderosa pine holdings near Libby and Lincoln, Montana, and on most national forest pine timber sales during the year.

Direct Control Programs Recommended For 1952

A function of the forest insect reconnaissance surveys conducted by the laboratory is the determination of the need for controlling current infestations. Although it is simply stated, this sometimes can be a difficult task. Certain insect infestations running rampant and causing serious depletion of timber resources or even threatening to wipe them out completely, obviously are in need of control. The need for controlling other infestations often is more difficult to determine. Assuming adequate methods are available, control projects seldom can be undertaken short of 6 months or even a year from the time an infestation is appraised. The need for control must then take into consideration the probable magnitude of the infestation thence, as evidenced by its present characteristics. The laboratory can and does recognize certain characteristics that help in establishing the trend of an infestation for the coming year, whether or not it will cause significant tree injury or mortality if it persists, and the type and amount of damage that probably will occur. It needs the help of the timber owner, however, and his evaluation of the damage, before a sound control recommendation can be made. In practice the laboratory may make a control recommendation justified upon entomological considerations or, with the advice of the timber owner or manager, upon some economic considerations. It is the timber owner or manager, however, who must weight the need for control against his ability to carry out the work and who must determine whether the value of the trees to be protected justifies the cost of controlling the infestation.

Based upon the results of the insect surveys made in 1951, the laboratory has recognized the need for direct control action in connection with 4 epidemic infestations now current in the region. These are summarized in Table 11.

Table 11. Summary of direct insect control action recommended by the laboratory for the northern Rocky Mountains in 1952.

	Area	Insect Species	Host Tree Species	In Need Of Treatment: No. of Acres	In Need Of Treatment: No. of Trees	Recommended Method Of Treatment 1/	Justification
1.	Swan River Valley, Flathead N. F., Montana	Spruce budworm	Douglas fir	25,000		Broadcast aerial spraying	To prevent the further buildup of the infestation in this area and its subsequent spread northward into valuable Christmas tree producing areas.
2.	E. Fk. and W. Fk. Bitterroot River, Bitterroot N.F., Montana	Spruce budworm	Douglas fir	12,000		Broadcast aerial spraying	To test the possibility of exterminating low magnitude infestations on small areas.
3.	Windy Cr., Solo Joe Cr., S. Boulder Cr., & Hensley Hill, Kootenai N.F., Montana	Mountain pine beetle	Lodgepole pine	2,020	994 ± 230	Spray standing infested trees	To continue action begun in 1951 to suppress an epidemic infestation.
4.	Thompson River - Lynch Lake, Cabinet N.F. Montana	Mountain pine beetle	Lodgepole pine	8,450	5,810 ± 952	Spray standing infested trees	To continue action begun in 1950 to suppress an epidemic infestation.
	Sub-Totals	-- Defoliating Insects		37,000			
		- Bark Beetles		10,470	6,804		
			TOTALS	47,470	6,804		

Indirect Control Programs Recommended For 1952

The laboratory has made no specific recommendations for indirect control programs in 1952.

It is known that the owners of several large tracts of ponderosa pine in Flathead, Lincoln, and Lewis and Clark Counties, Montana, contemplate additional sanitation-salvage cuttings during 1952 to prevent the buildup of western pine beetle infestations in the residual stands in the near future. The Forest Service undoubtedly will continue its policy of incorporating the removal of all high insect risk trees into ponderosa pine timber sales to be made during the year. This same feature also is expected to be made a part of many western white pine timber sales on national forests in 1952.

Realizing that direct control will be an expensive and difficult undertaking, private, State, and Federal owners may elect to institute indirect control operations during 1952 in timberlands threatened by the mountain pine and Douglas-fir beetle epidemics now sweeping parts of the Clearwater River basin in northern Idaho. This may take the form of a salvage operation to utilize timber values in some 240,000 white pine and 215,000 Douglas-fir infested trees, and of utilization cuttings of some kind to place the stands under more intensive forest management so that future epidemics of this magnitude will be prevented from developing in them.

It is believed that most owners and managers of commercial forest properties in the northern Rockies have realized for some time that direct control of insect outbreaks is only a stop-gap measure and that, as with forest fires, it is a much more sound practice to control them in their incipiency, or better, to prevent them altogether, than to try to cope with them after they have become virulent epidemics. Entomologists and foresters working together have demonstrated on many occasions that proper forest management is the key to permanently effective insect control in many commercial forest types, and that forest management, in turn, cannot be undertaken successfully until each forest area is made fully accessible by a good maintained road system. Not until such development is completed can there be any assurance of preventing the destructive insect outbreaks that constitute one of the greatest impediments to maximum forest production in the region today.

A P P E N D I X

Appendix Table 1. Summary of detection survey reports submitted to the Coeur d'Alene laboratory in 1951.

Report No.	Area	Observer	Agency[1]	Date of Exam.	Insect Found	Host[2]
	COLVILLE N.F., Wash.					
1	Deadman Creek	Geo. F. Christensen	USFS	7/13	Tent Caterpillar	ASP
	KANIKSU N.F., Idaho					
2	Media Creek	J. R. Jansson	USFS	5/23	Doug.-fir beetle	DF
3	Lamb Creek	"	"	"	Mtn. pine beetle	WWP
4	Cascade Creek	Millard Evenson	"	10/15	Carpenter bees	DF
5	Slate-Styx Crs.	C. W. Wetterstrom	"	10/1	E. spruce weevil	ES
6	Sullivan Creek	"	"	"	Doug.-fir beetle	DF(W)
					Mtn. pine beetle	WWP(W)
					E. spruce beetle	ES
7	Slate-Styx Crs.	"	"	"	Spruce gall aphid	ES
8	Stony-Pass Crs.	"	"	"	Mtn. pine beetle	WWP(W)
					"	LPP(W)
9	Exper. Station	S. S. Evans	"	10/12	Doug.-fir beetle	DF
	COEUR D'ALENE N.F., Idaho					
10	Alder Gulch	Henry Kottkey	USFS	7/17	Doug.-fir beetle	DF
11	Wallace District	J. E. Sanderson	"	10/17	" " "	"
		"	"		Mtn. pine beetle	WWP
12	Cascade Cr.	Wm. W. Larson	"	10/15	Doug.-fir beetle	DF
	Iron Creek	"	"	"	"	"
	Picnic Creek	"	"	"	"	"
	Bootjack Creek	"	"	"	"	"
	Solitaire Cr.	"	"	"	"	"
	Crooked Ridge	"	"	"	"	"
13	N. Fk. Cd'A. River	Wallace E. Kenyon	"	10/12	"	"
	ST. JOE N.F., Idaho					
14	Willow Creek	C. E. Powell	USFS	5/16	Doug.-fir beetle	DF
15	Elk Creek	"	"	7/5	"	"
16	Latah Creek	"	"	8/11	"	"

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	ST. JOE N.F., Idaho Cont.					
17	Latah Creek	C. E. Powell	USFS	8/18	Doug.-fir beetle	DF
18	Mannering Cr.	"	"	8/16	"	DF
19	Santa Creek	"	"	5/10	"	"
20	Santa Creek	"	"	10/10	"	"
21	Palouse River	"	"	10/10	"	"
22	Potlatch Creek	"	"	10/10	"	"
23	Sisters Basin	Gordon Cornell	"	7/11	Mtn. pine beetle	WWP
24	Boulder Creek	Rolf P. Perkins	"	8/24	Doug.-fir beetle	DF
25	Bond Creek	Geo. W. Carl	"	6/26	"	"
26	Mica Creek	R. Brandenberger	"	6/13	"	"
27	Kelly Ridge	R. C. Christiansen	"	5/29	Wood borers	WL
28	Quartz-Gold Crs.	R. G. Perkins	"	10/5	Mtn. pine beetle	LPP
					" " "	WWP
29	Calder	Lloyd V. Donally	"	10/10	Doug.-fir beetle	DF
	CLEARWATER N.F., Idaho					
30	N. Fk. Clearwater R.	Geo. DeJarnette	RO	9/6	Doug-fir beetle	DF
	NEZPERCE N.F., Idaho					
31	Selway River	Glenn L. Boy	USFS	5/1	Needle blight	PP
32	"	"	"	10/11	Doug.-fir beetle	DF
	Meadow Creek	"	"	"	"	DF
33	Kessler Creek	Rolf Jorgensen	"	10/8	West. pine beetle	PP
					Oreg. engraver beetle	"
	Squaw Creek	"	"	"	"	"
					West. pine beetle	"
	Corral Creek	"	"	"	"	"
					Oreg. engraver beetle	"
	John Day Creek	"	"	"	"	"
					West. pine beetle	"
	Whitebird Ridge	"	"	"	"	"
					Oreg. engraver beetle	"

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	NEZPERCL N.F., Idaho Cont.					
34	Salmon River	Rolf Jorgensen	USFS	10/8	Spruce budworm	DF
					"	GF
					"	AF
35	Big Cove Creek	Dale S. Arnold	"	10/12	Doug.-fir beetle	DF
36	Green Creek	"	"	"	West. pine beetle	PP
					Oreg. engraver beetle	"
37	Meadow Creek	J. C. Crupper, Jr.	"	10/8	West. pine beetle	"
					Oreg. engraver beetle	"
	Rock Cr.	"	"	"	"	"
					West. pine beetle	"
38	Wind River	"	"	"	"	"
					Oreg. engraver beetle	"
	Slate Creek	"	"	"	"	"
					West. pine beetle	"
	John Day Cr.	"	"	"	"	"
					Oreg. engraver beetle	"
39	Mid. Fk. Clearwater R.	John W. Johnson	"	10/3	"	"
					Mtn. pine beetle	"
40	Smith Creek	"	"	"	Doug.-fir beetle	DF
					Spruce budworm	"
	KOOTENAI N.F., Mont.					
41	Bear Creek	S. K. Beebe	USFS	5/23	Mtn. pine beetle	WWP
42	Rainy Creek	Ernest J. Grambo	"	8/29	Undetermined	PP
43	N. Fk. Meadow Cr.	John Milodragovich	"	9/21	Mtn. pine beetle	WWP
44	Hensley Hill	"	"	"	"	LPP
45	Beaver Creek	"	"	"	"	"
46	Lap Creek	"	"	"	"	"
47	Hensley Hill	M. D. Oaks	"	10/11	"	"
	Solo Joe Creek	"	"	"	"	"
	Windy Creek	"	"	"	"	"
48	Boulder Creek	"	"	"	"	"

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	CABINET N.F., Mont.					
49	Patrick Creek	Mr. Waldron	USFS	6/20	Climatic injury	PP
	LOLO N.F., Mont.					
50	Clark Fork River	F. J. Hirst	USFS	4/26	West. pine beetle	PP
					Turpentine beetle	"
51	Cottonwood Lakes	Rolland Huff	RO	6/19	Doug.-fir beetle	DF
52	Seeley Lake	Horace W. Godfrey	USFS	10/10	Spruce budworm	"
					E. spruce weevil	ES
53	Cottonwood Lakes	"	"	"	Doug.-fir beetle	DF
					Mtn. pine beetle	PP
54	Mineral Lookout	Victor P. Parent	"	10/8	Undetermined	DF
55	Harvey-N. Willow Crs.	W. K. Samsel	"	10/16	Spruce budworm	"
	BITTERROOT N.F., Mont.					
56	Moose Creek	Jack A. Parsell	USFS	8/13	Doug.-fir beetle	DF
	Selway R. (Idaho)	O. F. Schumaker	"	6/22	Oreg. engraver beetle	PP
57	Deep Creek (Idaho)	"	"	10/1	Doug.-fir beetle	DF
	White Cap Cr. (Ida.)	"	"	"	"	"
	Magruder Cr. (Ida.)	"	"	"	"	"
	Selway R. (Idaho)	"	"	"	"	"
58	W. Fk. Bitterroot R.	M. J. Sullivan	"	7/23	Spruce budworm	"
59	"	Sam'l. J. Billings	"	10/12	"	"
					Doug.-fir beetle	"
60	Bluejoint	"	"	10/5	Needle blight	PP
61	St. Marys Cr.	C. H. McDonald	"	10/8	Mtn. pine beetle	PP(W)
	Cow Creek	"	"	"	"	"
62	Stevensville	"	"	"	Needle blight	PP
	FLATHEAD N.F., Mont.					
63	Ashley Creek	V. I. Carter	USFS	5/30	Spruce budworm	DF
64	Glacier-Crescent Crs.	Jack R. Alley	"	6/25	E. spruce beetle	ES
65	Canyon Creek	Wm. L. Morris	"			
		Arnold H. Dillard	"			
		John R. Castles	"	7/21	"	"

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	FLATHEAD N.F., Mont. Cont.					
66	Soup Creek	V. H. Eastman	USFS	7/2	Spruce budworm	DF
67	S. Fk. Flathead R.	Glenn A. Maryott	"	8/1	"	"
					Doug.-fir beetle	"
	HELENA N.F., Mont.					
68	Townsend District	Verne J. Edwards	USFS	8/20	Spruce budworm	DF
69	Kinney-Elliston Guls.	L. R. Olsen	"	8/9	"	"
70	Helena District	Eric D. White	"	10/11	"	"
71	Clancey Creek	"	"	8/6	"	"
72	Ten-Mile Creek	"	"	"	"	"
73	Canyon Ferry Dist.	C. M. Hofferber	"	10/2	"	"
74	Canyon Creek	John W. Venrick	"	10/11	"	"
	Tarhead Creek	"	"	"	"	"
	Trout Creek	"	"	"	"	"
	LEWIS & CLARK N.F., Mont.					
75	Spring Creek	John S. Forsman	USFS	8/20	Mtn. pine beetle	PP
76	Mussellshell Dist.	"	"	10/2	Spruce budworm	DF
77	S. Fk. Judith River	Dan'l. G. Massing	"	10/29	Matsucoccus scale	PP
78	Mid. Fk. Judith R.	"	"	10/2	Mtn. pine beetle	"
79	"iller Gulch	George Holmes	"	10/6	Spruce budworm	DF
	GALLATIN N.F., Mont.					
80	Sunlite Creek	W. S. Chapman	BRC			
		J. C. Gynn	"	6/6	E. spruce beetle	ES
81	Beattie Gulch	D. E. Niven	USFS	10/8	Spruce budworm	DF
82	Bridger Canyon	Howard D. Halpin	"	10/9	"	"
83	Shields District	F. B. Haller	"	10/8	"	"
	BEAVERHEAD N.F., Mont.					
84	Wisdom District	Richard G. Gallup	USFS	10/12	Spruce budworm	DF

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	CUSTER N.F., Mont.					
85	Squaw Gulch	R. A. Watters	USFS	10/10	Doug.-fir beetle	DF
86	Ft. Howes District	John R. Lyman	"	10/3	Ips spp.	PP
87	Ekalaka District	Melvin C. Aaberg	"	10/6	"	"
88	Spoelman-Tie Crs.	Chester Hagedorn	"	10/2	Black Hills beetle	"
	GLACIER N.P., Mont.					
89	Kintla Lake	Bruce J. Miller David G. Stimson	NPS	7/30	Doug.-fir beetle	DF
	PEND ORFILLE CO., Wash.					
90	Little Pend Oreille Nat'l. Wildlife Refuge	H. G. Potter	FWLS	5/16	Oreg. engraver beetle	PP
	SPOKANE CO., Wash.					
91	Turnbull Nat'l. Wildlife Refuge	W. A. Rodgers	FWLS	4/12	"	"
	SHOSHONE CO., Idaho					
92	Norton Cr.	Marion Nance	BLM	11/9	An aphid	GF
	BONNER CO., Idaho					
93	Hope (townsite)	Mrs. H. T. Stearns		7/10	Spruce gall aphid	DF
					"	ES
					An aphid	GF
	KOOTENAI CO., Idaho					
94	Coeur d'Alene, City	A. G. Morris		5/18	Oreg. engraver beetle	PP
					"	LPP
95	" "	Virgil L. McEuen		7/30	June beetles	
96	Fernan Lake	Don Campbell		7/30	Oreg. engraver beetle	PP
97	Tesemini Island	Mrs. W. P. Hopkins		7/27	Willow borer	W
98	Lower Twin Lake	Dwight Slawson		7/10	Oreg. engraver beetle	PP
					Turpentine beetle	"
99	Lake Coeur d'Alene	John Dennis	RPL	6/1	Oreg. engraver beetle	"

Appendix Table 1 cont.

Report No.	Area	Observer	Agency 1/	Date of Exam.	Insect Found	Host 2/
	LATAH CO., Idaho					
100	E. Fk. Potlatch Cr.	Garry B. Ringold	PFI	6/19	Mtn. pine beetle	WWP
	CLEARWATER CO., Ida.					
101	Whiskey Cr.	D. B. Hunter	PFI	5/16	Doug.-fir beetle	DF
102	N. Fk. Clearwater R.	Royce G. Cox	"	8/23	Needle cast	WL
103	Elk Cr.	Grant B. Potter	OM	9/8	Doug.-fir beetle	DF
104	N. Fk. Reeds Cr.	Marvin C. Riley	BRC	7/12	Mtn. pine beetle	WWP
105	S. Fk. Clearwater R.	Boyd Olson		9/6	West. pine beetle	PP
106	Snake Creek	N. F. Mobley A. G. Darrach Robt. L. Nelson	PFI	4/20	Doug-fir beetle	DF
	FLATHEAD CO., Mont.					
107	Kalispell Valley	E. A. Anderson	MSF	7/18	Oreg. engraver beetle	PP
	LAKE CO., Mont.					
108	Nat'l. Bison Range	R. E. Griffith	FWLS	4/24	West. pine beetle	PP
	POWELL CO., Mont.					
109	Nevada Cr.	Geo. Weyerman	RO	8/2	Spruce budworm	DF
	LINCOLN CO., Mont.					
110	Wapati Mtn.	Orlo Johnson	JNL	9/13	Mtn. pine beetle	LPP
	LEWIS & CLARK CO., Mont.					
111	Lincoln Basin	George Neff	ACM	9/17	Turpentine beetle	PP

Appendix Table 1 cont. (Footnote)

1/ Abbreviations of reporting agencies

USFS - U. S. Forest Service
FWLS - U. S. Fish and Wildlife Service
BLM - U. S. Bureau of Land Management
BRC - U. S. Bureau of Entomology and Plant Quarantine, Blister Rust Control
NPS - National Park Service
MSF - Montana State Forester (Assistant)
PFI - Potlatch Forests, Inc., Lewiston, Idaho
OM - Ohio Match Co., Coeur d'Alene, Idaho
RPL - Russell and Pugh Lumber Co., Springston, Idaho
JNL - J. Neils Lumber Co., Libby, Montana
ACM - Anaconda Copper Mining Co., Bonner, Montana

2/ Abbreviations of host tree species

PP - Ponderosa pine
WWP - Western White Pine
LPP - Lodgepole pine
ASP - Aspen
W - Willow
GF - Grand fir
DF - Douglas fir
AF - Alpine fir
WL - Western larch
ES - Engelmann spruce
(W) - Windfelled trees

Appendix Table 2. List of cooperating agencies submitting detection survey reports to the Coeur d'Alene laboratory in 1951.

Cooperating Agency		No. of Reports
U. S. Forest Service		
National Forests -	Colville	1
	Kaniksu	8
	Coeur d'Alene	4
	St. Joe	16
	Nezperce	10
	Kootenai	8
	Cabinet	1
	Lolo	5
	Bitterroot	7
	Flathead	5
	Helena	7
	Lewis & Clark	5
	Gallatin	3
	Beaverhead	1
	Custer	4
Regional Office		3
U. S. Fish and Wildlife Service		3
U. S. Bureau of Land Management		1
U. S. Bureau of Entomology and Plant Quarantine, Blister Rust Control		2
National Park Service		1
Montana State Forester's Office		1
Potlatch Forests, Inc.		4
Ohio Match Co.		1
Russell and Pugh Lumber Co.		1
J. Neils Lumber Co.		1
Anaconda Copper Mining Co.		1
Individuals, no agency affiliation		7
		111

Appendix Table 3. List of forest insects mentioned in detection survey reports received by the Coeur d'Alene laboratory in 1951.

Insect Species	No. Times Mentioned
Douglas-fir beetle	45
Spruce budworm	27
Mountain pine beetle	26
Oregon engraver beetle	21
Western pine beetle	14
Non-insect factors	5
Aphids, various species	4
Red turpentine beetle	3
Engelmann spruce beetle	3
Engelmann spruce weevil	2
Undetermined	2
Ips species	2
Forest tent caterpillar	1
Carpenter bees	1
Wood borers	1
Matsucoccus scale	1
June beetle	1
Willow borer	1
Black Hills beetle	1
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Appendix Table 4. List of forest insect reconnaissance surveys conducted in the northern Rocky Mountains in 1951.

Area	Period of Survey	Total Acreage Covered	Size of Sample 1/			Insect Species Found	Host Tree Species	No. of Man-days	Survey Made by
			Miles of Strip	Acreage of Strips	No. Trees Examined				
POTLATCH TIMBER PROT. ASSN., Idaho									
1. Boehls Cabin	July	65,900			3,107	Mtn. pine beetle	W. white pine	20	Laboratory
2. " "	Sept.	72,200			18,619	"	"		
					2,654	Doug.-fir beetle	Doug.-fir	63	"
ST. JOE N.F., Idaho									
3. St. Joe River	July	100,500			9,763	Mtn. pine beetle	W. white pine	41	"
CLEARWATER N.F., Idaho									
4. N. Fk. Clearwater R.	Aug.	90,600			16,571	"	"	45	"
CLEARWATER TIMBER PROT. ASSN., Idaho									
5. Benton Cr.	Sept.	7,000			1,324	Doug.-fir beetle	Doug.-fir	4	"
6. Silver Cr.	Oct.	15,000			1,239	Mtn. pine beetle	W. white pine		"
					311	Doug.-fir beetle	Doug.-fir	6	Idaho State Forester

Appendix Table 4 cont.

Area	Period of Survey	Total Acreage Covered	Size of Sample 1/			Insect Species Found	Host Tree Species	No. of Man-days	Survey Made by
			Miles of Strip	Acreage of Strips	No. Trees Examined				
COEUR D'ALENE N.F., Idaho									
7. N. Fk. Cd'A River	Aug.	8,780	23	184		Mtn. pine beetle	W. white pine	9	Laboratory
CABINET N.F., Mont.									
8. Thompson R.	Sept.	10,400	16	128		"	Lodgepole pine	6	"
KOOTENAI N.F., Mont.									
9. Yaak River	Oct.	4,800				"	"	22	J. Neils Lumber Co.
		375,180	39	312	53,588			216	

1/ Sampling either by continuous cruise strips on which 100 percent of the trees were basal-examined or by basal examinations of every tree on irregular, unplotted traverses.

Appendix Table 5. List of forest insect appraisal surveys conducted in the northern Rocky Mountains in 1951.

Area	Period of Survey	Total Acreage Covered	Size of Sample: Miles of Strip	Size of Sample: Acreage of Strips	Insect Species Found	Host Tree Species	No. of Man-days	Survey Made by
CLEARWATER TIMBER PROT. ASSN., Idaho								
1. Silver Creek	Oct.	2,880			Mtn. pine beetle	W. white pine	30	Laboratory, Ida. State Forester, Western Pine Assn., Potlatch Forests, Inc.
CLEARWATER N.F., Idaho								
2. Sheep Mtn.	Aug.	1,500	9	72	"	"	3	Laboratory
3. Tepee Cr.	"	1,090	7	56	"	"	3	"
ST. JOE N.F., Idaho								
4. State Line Unit	Sept.	10,300	55	440	"	Lodgepole pine	35	"
COEUR D'ALENE N.F., Idaho								
5. N. Fk. Cd'A. R.	Aug.	26,910	107	856	"	W. white pine	72	"
KOOTENAI N.F., Mont.								
6. Yaak River	Sept.	12,470	95	760	"	Lodgepole pine	55	"
7. Hensley Hill	Sept.	700	9	72	"	"	8	J. Neils Lbr. Co.

Appendix Table 5 cont.

Area	Period of Survey	Total Acreage Covered	Size of Sample: Miles of Strip	Size of Sample: Acreage of Strips	Insect Species Found	Host Tree Species	No. of Man-days	Survey Made by
CABINET N.F., Mont.								
8. Thomoson R.	Sept.	51,390	162	1,296	Mtn. pine beetle	Lodgepole pine	97	Laboratory
9. Wapati Mtn.	Oct.	3,250	16	126	"	"	6	J. Neils Lbr. Co.
BEAVERHEAD N.F., Mont.								
10. Jack Creek	Sept.	7,900	34	272	"	"	18	Laboratory
		118,390	494	3,950			327	

MAP LEGEND

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

LIGHT

HEAVY

MOUNTAIN PINE BEETLE

1951 EPIDEMIC INFESTATION IN WESTERN WHITE PINE

LIGHT

HEAVY

MOUNTAIN PINE BEETLE

1951 EPIDEMIC INFESTATION IN LODGEPOLE PINE

LIGHT

HEAVY

DOUGLAS-FIR BEETLE

1951 EPIDEMIC INFESTATION IN DOUGLAS-FIR

LIGHT

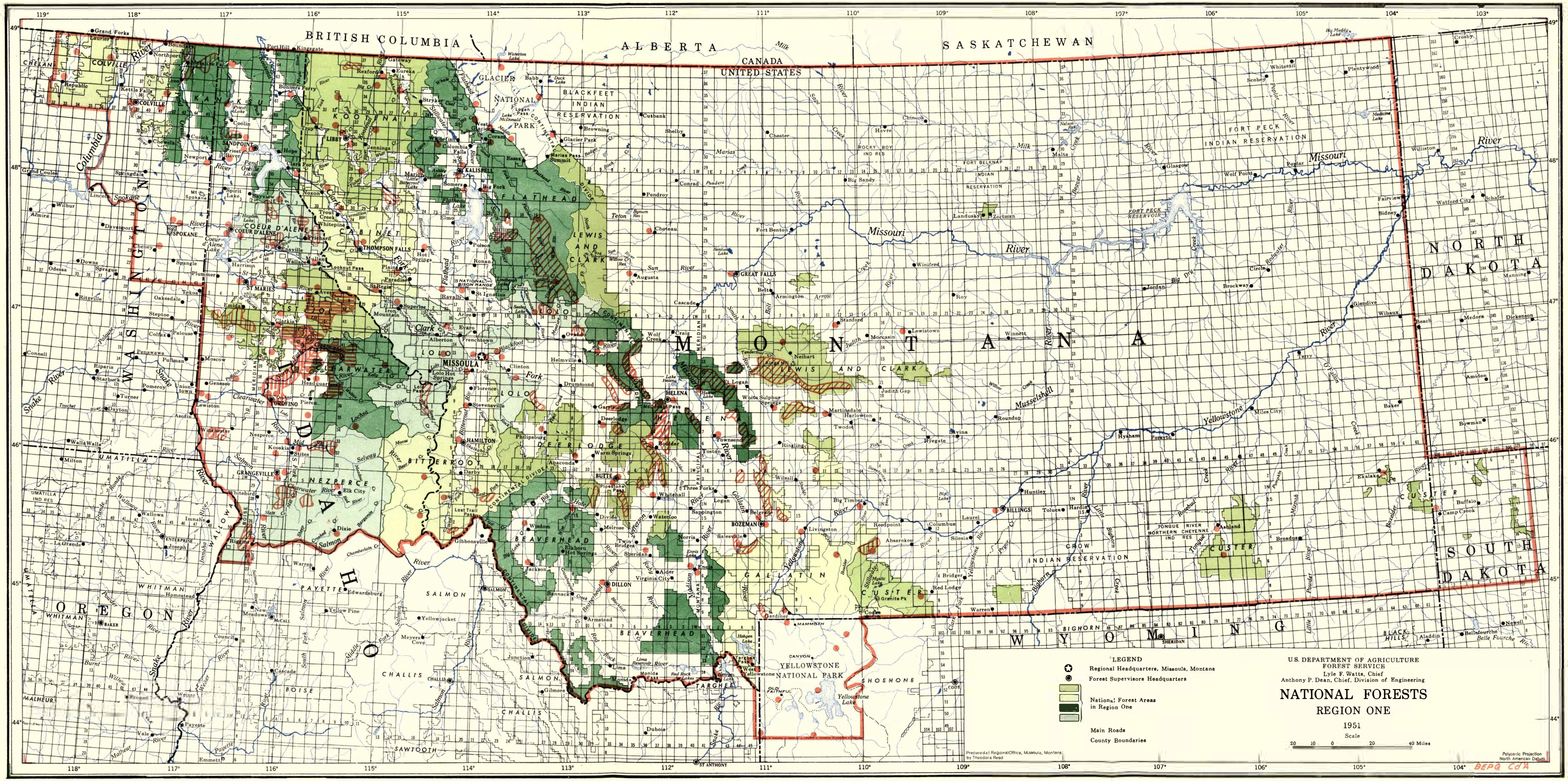
HEAVY

SPRUCE BUDWORM

1951 EPIDEMIC INFESTATION IN DOUGLAS-FIR AND ABIES

FOREST INSECT DETECTION SURVEY COOPERATORS

BOUNDARY OF REGION SERVED BY THE COEUR D'ALENE LABORATORY


BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
CANADA
UNITED STATES
MONTANA
IDAHO
WASHINGTON
OREGON
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
YELLOWSTONE NATIONAL PARK
GLACIER NATIONAL PARK
BLACKFEET INDIAN RESERVATION
FORT PECK INDIAN RESERVATION
CROW INDIAN RESERVATION
KANIKSU
KOOTENAI
FLATHEAD
LEWIS AND CLARK
COEUR D'ALENE
CABINET
ST JOE
CLEARWATER
NEZPERCE
LOLO
BITTERROOT
DEERLODGE
HELENA
BEAVERHEAD
GALLATIN
CUSTER
LEGEND
Regional Headquarters, Missoula, Montana
Forest Supervisors Headquarters
National Forest Areas in Region One
Main Roads
County Boundaries
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Lyle F. Watts, Chief
Anthony P. Dean, Chief, Division of Engineering
NATIONAL FORESTS
REGION ONE
1951
Scale
20 10 0 20 40 Miles
Prepared at Regional Office, Missoula, Montana by Theodora Reed
Polyconic Projection
North American Datum
BEPQ CdA